YRKESHÖGSKOLAN
NOVIA

QR Code Utilization for VEO´s Vector Product for Maintenance and Service purpose

Kevin Grankull

Degree Thesis for Bachelor of Engineering

Degree Programme in Industrial Engineering and Management

Vasa 2020

BACHELOR'S THESIS

Author: Kevin Grankull

Degree Programme: Industrial Engineering and Management

Supervisor(s): Mikael Ehrs, Novia University of Applied Sciences

Ari Pätsi, VEO Oy

Title: QR Code Utilization for VEO´s Vector Product for Maintenance and Service purpose

---

Date: 18th February 2020 Number of pages: 43 Appendices: 0

Abstract

The bachelor thesis has been done for VEO Oy's development department and their recently released switchgear Vector. VEO Oy is an engineering company that focuses on delivering tailored made solutions for automation, drives and distribution for customers in energy and process industries.

The purpose of the thesis was to investigate Fusetwins solution for linking QR codes and mobile application for improving project documentation, customer support and documentation of maintenance. Investigate how this would be implemented and what would be needed from both parties.

Result of the thesis was achieved by the qualitative research method. Qualitative research method was chosen since it's a new solution for VEO and no earlier information or data was available. Interviews, workshops and discussions has been conducted with employees from VEO and Fusetwin for gathering information to reach the purpose of the thesis.

Addressing in the results that VEO's current documentation system can't be linked with Fusetwins application and changes in VEO's own documentation system would be required. Current business model is presented for the application and its features.

Language: English Key words: QR code, mobile application, documentation

---

EXAMENSARBETE

Författare: Kevin Grankull

Utbildning och ort: Produktionsekonomi, Vasa

Handledare: Mikael Ehrs, Yrkeshögskolan Novia

Ari Pätsi, VEO Oy

Titel: Användning av QR kod för VEO's Vector produkt för underhållning och servicesyfte

---

Datum: 18 Februari 2020 Sidantal: 43 Bilagor: 0

Abstrakt

Detta examensarbete har gjorts för produktutvecklingsavdelningen för VEO Oy och deras nylanserade ställverk Vector. VEO är ett ingenjörsföretag som fokuserar sin verksamhet på att automatisera och elektrifiera genom att leverera projekt specifika lösningar för kunder inom energi och process branschen.

Syftet med examensarbetet var att undersöka användningen av Fusetwins lösning att kombinera QR koder med en mobil applikation för att förbättra projektdokumentering, kundsupport och dokumentationen av serviceunderhållning. Undersöka hur detta skulle ske i praktiken och vad som skulle behövas från båda parterna till att verkställa denna lösning.

Examensarbetets resultat har åstadkommits med hjälp av den kvalitativ forskningsmetoden. Den kvalitativ forskningsmetoden har valts för att detta är en ny teknologi som VEO valt att undersöka och ingen tidigare information fanns till hands. Intervjuer, workshops och diskussioner har hållits för att samla information för att uppnå syftet med examensarbetet.

I resultatet förklaras att i nuläget går inte applikationen att länkas med VEO's dokumenterings system och förändringar i VEO's dokumenterings system skulle behöva ske. Nulägets affärsmodell av Fusetwin presenterats samt funktionerna av applikationen.

Språk: Engelska Nyckelord: QR kod, mobilapplikation, dokumentering

---

Table of Contents

1 Introduction

This chapter will give the reader an insight on the thesis. Background of the thesis, purpose and delimitation will be described for the thesis. Concluding the chapter with disposition setup of the thesis.

1.1 Background

This thesis work is done for the product development department of VEO for their medium voltage switchgear called Vector.

Today companies are trying to keep up with the digitalization that is taking place in the world and the opportunities that it can bring to a company and its products. Therefore, VEO are looking into if the use of QR codes and if implementing QR codes could bring value for the company as well as their customers. Vector as a product contains a lot of parts, information and is also extensively tailored made for each project or customer.

When a project is sold and delivered, VEO must also deliver accordingly to the contract as a part of the final documentation certain documents related to the Vector product to the customer for operation, maintenance and service purposes. Another important aspect is to document the delivery from a guarantee perspective, VEO needs to be able to document and if necessary, prove to the customer in detail how the delivery was designed and configured at the time of hand over and start of warranty period.

The use of QR codes could help customers and VEO during the product life cycle to find the technical information about the switchgear and the products used and delivered to a customer for a specific project. The use of QR code technology also assist VEO to support their customers with project specific information of the delivered switchgear. The use of QR code and the appropriate software application therefore be a fast and easy way to get the required information to a stationary or mobile device.

If a customer, VEO or a maintenance and service supplier need to find information or a document when they are on site, it can be challenging and take time to find the right information. This information is usually stored as paper files at site and can easily be lost fully or partially and therefore not available when needed. Moving to storing and finding information digitally by using QR code technology and a suitable software application could

be a fast and convenient way to find specific project information without being connected to an archive database.

The companies Lasermark and Fusetwin reached out to VEO about their solution and application for use of QR codes.

1.2 Purpose

The purpose of this thesis work is to find out how using QR codes with an appropriate software application for the Vector life cycle product support could bring additional value for VEO and their customers. Values referring to availability/time saving, customer support, cost saving and improving document management.

Currently VEO is having some difficulties with keeping delivery documents at one place easily available when needed as they are stored as paper copies in the archive or on CD's depending of delivery year. To find required information stored in any of the described format is difficult and time consuming. Project specific documentation should be easy to find and accessible by having a platform where relevant documents gets uploaded and by using appropriate identification methods and software tools you should find the requested relevant documents stationary or mobile.

Having this kind of digital platform and tools makes it possible to provide better customer support by having manuals, instructions and parts lists easily available just by reading the QR code on site from the Vector product. Keeping track of the maintenance history by using QR codes is also one of the applications that is of interest and investigated in the thesis work.

Before the thesis work VEO has had internal discussions about the needs and about different kind of solutions that could bring value to VEO and their customers. QR coding came up as a method VEO wanted to investigate further. The use of QR codes and software applications were investigated and evaluated through workshops with employees from VEO and Fusetwin by gathering and sharing information on how VEO and their customers currently are working and on how new technology and methods could improve the information availability.

Since the use of QR codes is a brand-new solution and way of working for VEO there is no in-house knowledge, data or structures available. Therefore, the qualitative research method has been chosen as research method for this thesis. The research will be conducted through

workshops, interviews and discussions. A pilot project is planned to be done to further investigate, assess and verify the findings off this thesis. This will take place after the completion of this thesis.

This thesis aims to give VEO further insight in the use of QR codes and related software applications and provide VEO with theoretical and detailed information. The thesis should be a starting point to help VEO to decide if further efforts and investments are to be put into implementation of QR code technology and applications and whether this would bring value for VEO and their customers. More in detail what kind of data will be behind the QR code, utilize the QR technology to get red pen drawings to the documentation, what is needed from VEO's IT-structures to be able to implement QR codes with a smartphone application and why it would bring value for VEO and their customers.

1.3 Delimitations

VEO's product portfolio has a range of different products, but for this thesis we are only considering implementing QR codes for the Vector product. There will be only one QR code for the whole Vector switchgear (consisting of 1+n cabinets) or one for each cabinet on the Vector product instead of having multiple QR codes on different components and parts.

Having QR codes also on individual mechanical parts for Vector was considered, but after evaluations and discussion the conclusion was that the mechanical parts in Vector are the same for each project and can be tracked through drawings and parts list. For this reason, it isn't necessary to have QR codes for every individual part. Only on complete cubicles.

In this thesis VEO only wants to study the implementing of QR codes for the Vector product as a pilot project since Vector is a new product that was introduced to the market 2018 and major part of the documentation such as installation, maintenance, operational manuals are found in digital format available at VEOs website. VEO's aim is to explore if using QR codes would add further value to this digital documentation. If VEO finds the use of QR codes valuable they will potentially further develop the usage of the codes and also put them in use in other of their products.

1.4 Disposition

The thesis consists of six chapters:

Chapter two brief introduction of VEO and the Vector product.

Chapter three relevant theory and information supporting the thesis.

Chapter four methods used for the thesis to achieve its purpose.

Chapter five presenting the result of the thesis.

Chapter six conclusion, further research and comments of the thesis.

2 VEO Oy

VEO Oy former Vaasa Engineering Oy is a privately-owned global engineering company from Vaasa, Finland and was founded 6th December 1989. VEO focuses on providing automation, drives, power distribution tailored solutions to customers in the energy and process industry.

VEO Oy key figures 2018:

Figure 1. Key figures for VEO 2018.

VEO today are in a stage of growth and has recently acquisitioned companies in UK and Sweden for strengthening their market and enable continued growth. VEO has offices in Finland (Vaasa HQ & factory, Seinäjoki, Tampere, Paimio and Rovaniemi), Sweden (Västerås), Norway (Oslo) and United Kingdom (Burton on Trent). Currently VEO employs approximately 450 persons, 120 blue collar and 330 white collar employees.

VEOs primary product is project deliveries containing project services such as project management, engineering, commissioning, VEOs own products and other third-party products. Most important own products are:

- Vector - Medium voltage switchgear
- Veda - Low voltage switchgear
- Vecos - Panels for automation, control and protection solutions
- Prefabricated modular substation building
- Generator commander – Generator excitation, protection and control unit

VEO organization:

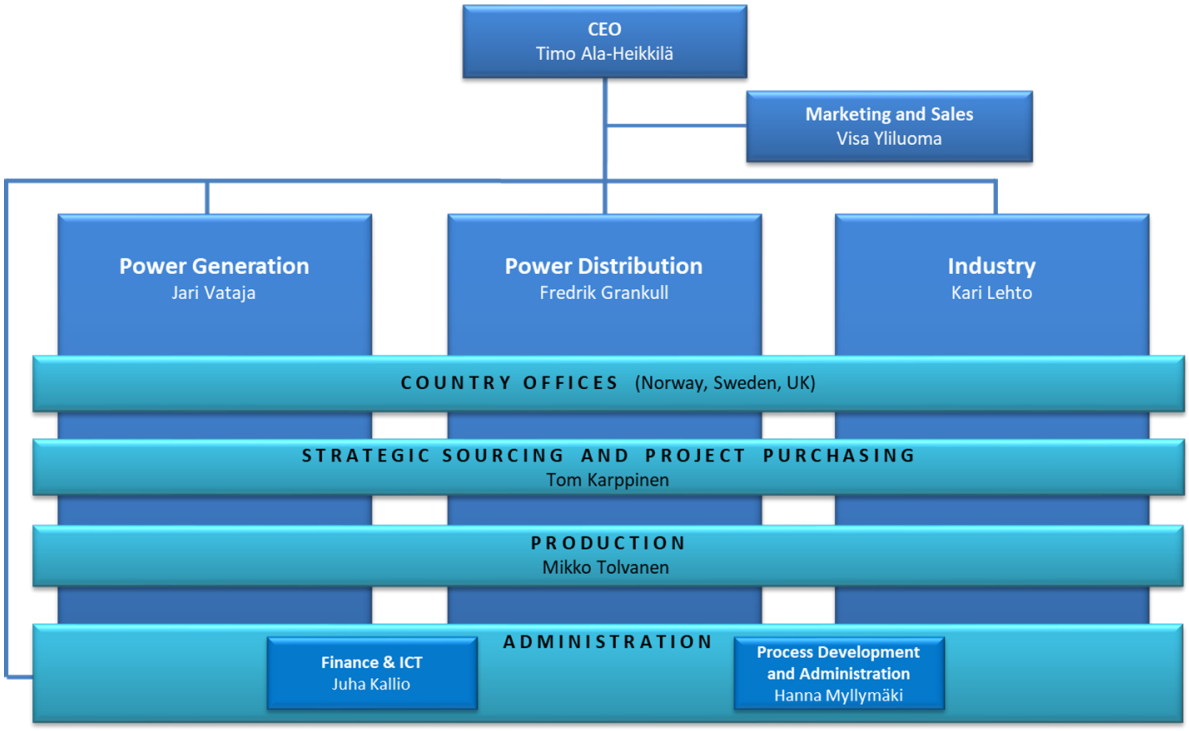

Figure 2. VEO organization chart.

VEO today are divided into three business units: power generation, power distribution and industry.

Power Generation

The power generation unit specializes on automation and electrification for power plants in hydro, oil & gas and thermal plants. The unit enables customers to run their plants more efficiently through using VEO´s offering of automation and electrification solutions.

Power generations main markets are in Finland and Norway with some projects in Sweden. Main customers amongst others are Wärtsilä, Fortum, Helsingin Energia, Eidsiva and Pohjolan Voima.

Power Distribution

VEO´s Power distribution unit delivers high voltage and Medium voltage substations for the Nordic countries as EPC (Engineering, Procurement and Construction) projects. Main focuses for the business unit is to provide medium and high voltage solutions for distribution, regional, national, utility companies, industries and wind park grid connections. The scope can vary between a full EPC to a product depending on customer's request.

The power distributions units' main markets found in Finland, Norway and Sweden. Main customers amongst others for wind power are EPV, Norsk Vind Energi, Taaleri, Ellevio, Vattenfall Distribution and Zephyr.

Industry

Process industries as pulp and paper, metals, mining, oil & gas and marine industry are business segments that VEO´s power utilization focuses on. The industry unit delivers customer tailored solutions as electrification, drives and automation systems to achieve cost-effectiveness and sustainable projects.

Industry's main market is in Finland. Main customers for Industry amongst others are Stora Enso, Outo Kumpu, Kemira, Neste Oil, Boliden and Holmen.

Vector

Vector is an air insulated medium voltage switchgear and control gear for indoor systems. All Vector units are produced in Vaasa factory. VEO can therefore secure that production and design teams are working together to achieve same goals.

Vector medium voltage switchgear is a Primary medium voltage switchgear used in distribution networks for medium voltage distribution, utility distribution, in wind and hydro power plants for internal process distribution and for the grid connection to the high voltage network. Vector is also used in the industry for medium voltage distribution to the process and grid connection.

Safeness ensuring personal safety had during the design of Vector a high priority. Combined electrical and mechanical interlockings protects user during operations and maintenance. Vectors reliability has been tested through different tests to ensure that it fulfills the latest IEC standards.

Environmental aspects have also been taken into consideration as in optimizing the size of Vector to reduce material usage and power dissipation. Vector is also free from SF6 gas due to vacuum technology. (VEO, 2018).

Figure 3. VEO's Medium Voltage Switchgear.

3 Theory

This chapter contains essential information and theory supporting the thesis. The focus is on how QR code and software application would be suitable for VEOs Vector product, employees and customers. The research method for the thesis will be explained.

QR codes will be explained with more information and background about what a QR code is and why keeping documentation is important. Presenting why and how another company in the same industry that have chosen to utilize QR technology to their business.

Method of research to accomplish the purpose of the thesis has been through interviews, workshops and discussions. Therefore, the qualitative research method has been chosen and will be further explained.

3.1 Qualitative research

For this thesis the qualitative research method been chosen since the data has been collected through interviews, workshops and open discussions. Therefore, theory of qualitative research is relevant and will be presented here.

Research can be divided into to two categories, qualitative and quantitative research. Quantitative research is done by studying numerical data that has been collected by statistical, logical and mathematical methods. Quantitative research can also be recognized as empirical research hence it can be measured exactly and accurately. (Surbhi, 2018).

Four factors that can be pointed out by why the qualitative method of research has been chosen by the researcher. Missing theory and earlier researches can be factors why the researcher would be choosing the qualitative research method. The available theory can be incorrect and therefore cannot be used for the purpose of the research. Requirements of searching and describing an experience with a theory. Last factor can be that the study cannot be carried out by quantitative research methods. (Creswell, 2008).

Qualitative research is often done by collecting data by visiting the actual place where the study takes place. Meeting up with the participants during issues and problems at the study place for having possibility to observe, notice behavior and how they act when the researcher has the possibility to observe face to face. (Creswell, 2008).

In qualitative researches the researcher functions as the main tool for collecting data by analyzing documents, behaviors and interviews. Often the researcher does not rely on only one specific source of data, instead collecting data from two or more sources as for example interviews and documents. (Creswell, 2008).

3.2 QR Code

QR code stands for Quick Response and is a two-dimensional barcode that is meant to be read by an optical reader. QR code was developed 1990 by a Japanese company called Denso Wave. Behind the code you can have information or a tracker that redirects you to a website or application when scanned. (Borko, 2011).

QR code is designed as well as protected by Denso Wave and can be specified by the industrial standard ISO/IEC18004. QR codes keeps information in both vertical and horizontal direction therefore it can hold up more amount of data then ordinary bar codes. Purpose of the development of the QR code was that it was easily read by the user. (Beker, 2011).

Figure 4. Difference between QR Code and Bar Code (Scan Me, 2010).

QR codes today can for example be spotted in product information as users manuals, price and basic information. In different transportation vehicles scanning the code so that you can get more information regarding the schedule. Business cards today can also just have a code that you scan for more information about the business or person that are handing you the card. (Winter, 2010).

QR codes also come in different codes. As seen below in table 2 there are six types of QR codes. These codes have features that difference them from each other.

QR Code Model 1and Model 2	Micro QR Code	iQR Code	SQRC	LogoQ
				
[Feature] Model 1 is the original QR Code. The largest version of this code is 14 (73 x 73 modules), which is capable of storing up to 1,167 numerals. Model 2 is an improvement on Model 1 with the largest version being 40 (177 x 177 modules), which is capable of storing up to 7,089 numerals. Today, the term QR Code usually refers to this type.	[Feature] Only one orientation detecting pattern is required for this code, making it possible to print it in a smaller space than before. This code can be viable even if the width of its margin is 2 module-worth (QR Code requires a margin of 4 module-worth at least around it). The largest version of this code is M4 (17 x 17 modules), which can store up to 35 numerals.	[Feature] Code that can be generated with either square modules or rectangular ones. Can be printed as a turned-over code, black-and-white inversion code or dot pattern code (direct part marking). The maximum version can theoretically be 61 (422 x 422 modules), which can store about 40,000 numerals	[Feature] QR Code that has a reading restricting function. Can be used to store private information or manage a company's internal information) Its appearance is no different from the regular QR Code.	[Feature] QR Code that can incorporate high-levels of design features such as illustrations, letters and logos. Since proprietary logic is used in generating this type of code, its readability is not compromised.

Figure 5. Types of QR codes (Denso Wave).

3.3 Pros and cons of applying QR codes

QR codes brings both pros and cons for a company that is investigating to take QR codes in use therefore it is necessary to give some research of them that needs to be kept in mind when implementing QR codes.

Pros

Digitalization brings modifications, developments, possibilities and threats from other companies. Old way of working gets replaced with faster new techniques, methods for a better and faster result. Therefore, companies cannot rely on old business models but needs to have a strategy for faster and flexible solutions. (Jansson & Andervin, 2016)

QR codes can provide faster connection between the company and customer with only a scan that could be performed with a mobile device on site. Through the QR code it would be

possible to get access to instruction manuals in writing but also have the same instruction on a video or animation for even more detailed ways of presenting the instructions to the user.

Also, more detailed information such as electrical and mechanical drawings and part lists can be linked and be accessible for further trouble shooting, service and maintenance purposes.

Malfunction of the product could also be troubleshooted by scanning the QR code for the customer to see troubleshooting and repair instructions. In an urgent situation the QR code could be have a number/email address that would be linked to someone that would be available and could give instant customer support. It could also be used for replacing parts or purchasing new parts. (CR-Codes, 2017).

QR technology also reduces printing costs and has an environmentally friendly impact by cutting down on paper documents for the company by having the information available through scanning the QR code and have the information digitally. (Bond, 2012).

Cons

There are also a few disadvantages QR codes brings:

The obvious one is that you need a smartphone to scan the QR code. Also not having the software of the QR code reader installed are going to make the user missing out of the information and the benefits from the QR code. (Oragui, 2018).

Damaged QR code can be restored but depending on how much its damaged and the correction level. Depending on how much storage the designer wants to put on correction level. With the lowest L level, you can restore a QR code that is damaged up to 7% and with the highest H level 30%. Depending on what the designer wants to have focus on, higher capability to restore damaged QR code or more storage data. (Taylor, 2017).

One of the biggest disadvantages with QR codes can be that people are unfamiliar with the use of the QR code technology. The unfamiliarity makes the user uncertain on how to use the technology and would want to have training before using it. (Advantages-disadvatages, n.d.).

3.4 Importance of documentation

Importance of documentation is relevant due to one of the reasons for why VEO is looking into QR codes and the mobile application is to improve VEO's documentation. With a digital platform for improving structure on how and where to keep correct documentation. Addressing theory regarding importance of documentation is therefore relevant for the thesis.

Like the saying "time is money" searching for a document through company folders and own personal folders can be very time consuming and frustrating. By having structured and organized documents, time will be saved on man-hours and reduce mistakes to be made. This will result in a boost of productivity of the employees hence instead of searching for a document other works can be done which means that a more efficient workday can be carried out by the employees. (IC, 2018).

Documentation when working with customer and vendor creates trust. It creates accountability between parties because the scope has been documented, resulting in clarifying the scope and reinforces what has been agreed upon. (Halvorsen, 2011).

When a documentation is made the challenging part is to keep the documentation updated to achieve its purpose. Time and resources to keep the documentation up to date needs to be prioritized, so that the stream of information as changes, updates, errors and feedback can maintain in the documentation chain. (Kleinman, 2012).

From a customer perspective its critical to have correct documentation to create a channel between the company and its customer. Having the link between each other creates a customer centric focus and a pro-activity culture. Documenting customer history makes it possible for better customer support, creating customer satisfaction by being able to support with giving solutions and answers promptly from previous history notes that has been documented. (Newman, 2016).

3.5 The use of a mobile app

Since the mobile app is one key function for implementing QR codes for VEO relevant theory on which elements are fundamental for the app to contain for getting the best user experience when using the mobile app.

Four key elements for a mobile app:

Simplicity

The user interface needs to be simple, simple relates to user-friendly. It is one of the key features for an application. If the app is made to difficult for the user and user gets a feeling that he/her needs to spend too much time learning the app before seeing its value the user will not see the point of using it. (State, 2017).

Understanding the user that are going the use the app will also help designing the app to get the most user-centric app. Evaluate feedback from the users to then further develop the app for receiving the best result. (Nagar, 2019).

Offline mode

The app should be in both online and offline mode available, giving the support that the customer needs. Users today wants an app that also works in offline mode if internet connection is not available. (Nagar, 2019).

Customer support

Having a feature that gives the users a possibility to reach out for help and support if needed with a fast response time for solving the user's problem that may occur when interacting with the app for high customer satisfaction. (Nagar, 2019).

Performance

Users that are using the app wants to find the information as fast as possible. Fast load times are key for the user to keep using the app therefore speed should be in focus for the developers. (Shaoolian, 2017).

3.6 Usage of QR technology in ABB for service purpose

This part of the theory chapter was to research and investigate if other companies in similar industry uses QR technology. How are they utilizing the technology and what was their main goals they desired to achieve with the implementation of QR codes?

In the end of 2017 ABB took in use dynamic QR codes for their gas analyzers for optimizing the use of the analyzers and for improving the product service. The dynamic QR code is a

development of a statistical QR code which means that the linked end address can be changed and re-direct the user to another address when scanning the QR code.

How QR codes came into the picture for ABB was that they recognized problems with customers on-site when the operator did not have expertise for solving/finding the problems. Contacting an ABB office for support wasn't the optimal solution for utilizing todays digital era.

Main goals with implementing dynamic QR codes for ABB were to simplify the process service which would result in shorter time of repair, operator efficiency and improve plants operative time. Through dynamic QR codes linking ABB, product and customer creates a new way of giving customer support and service.

Three key factors why ABB ended up choosing and implementing QR technology for the gas analyzers:

- Fastness
- Familiar
- User-friendly

From data received from using QR codes ABB developed a software called ABB Ability. ABB Ability software is linked to a smartphone application called myIB where the user can scan QR codes, report product issues, request support, view product reports, view documents such as technical, operations and maintenance documents on case specific products. The software gives ABB the possibility to collect data behind the QR code in summary reports that then can be linked with ABB's installed base storage and management system called ServIS. When these platforms are linked together the user can generate an action plan for how to do the service.

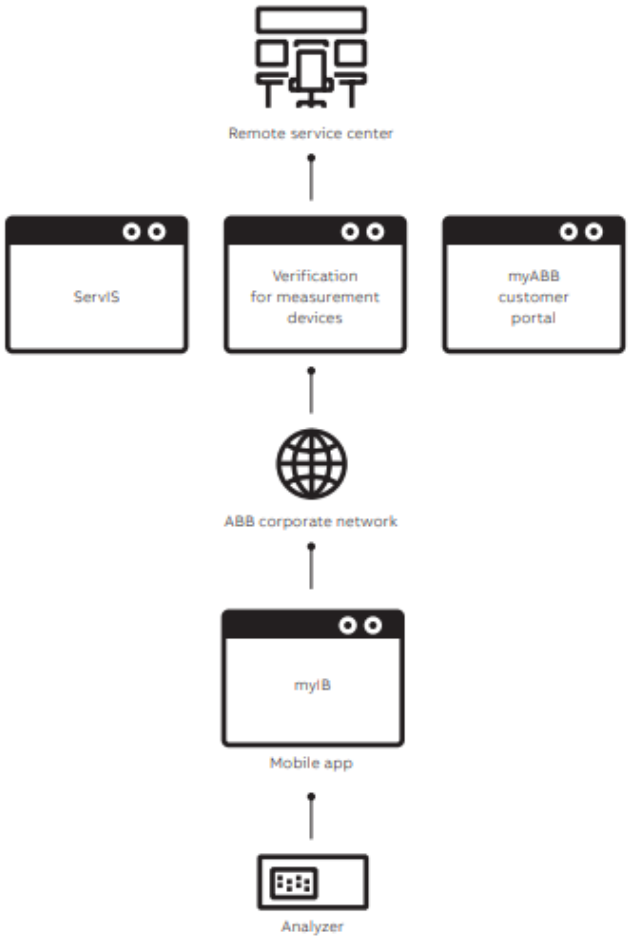

Figure 6. ABB QR code technology. (ABB,2018)

What QR code technology brings in the future for ABB is a faster and more optimal way of troubleshooting, proactiveness, faster problem solving, giving more remote tools for the operator, less downtime and better use of resources. (Lincoln & von-Hoersten, 2018)

Having a global corporation as ABB in the same industry that utilizes QR technology for their gas analyzers is a good indication for VEO that ABB have seen the potential and advantages for elevating customer support and service.

4 Method

This chapter will present reasons why VEO are looking into using QR codes. Also, how the documentation is structured currently at VEO and their customer. A brief introduction of Lasermark and Fusetwin will also be presented. The research method of interviews and workshops will also be explained more in detail. Ending method chapter with a presentation of Fusetwins demo app and some conclusions for the app.

4.1 Data collection

The main source of data has been gathered through interviews and workshops. The workshops were held with development manager, business developer and software developers in order to receive input from their expertise of area.

4.2 Lasermark and Fusetwin

Lasermark are specialized on laser marking and has been developing this method in the market for 30 years. Lasermarks laser marking can be seen in pharmaceutical, printing, process, and energy industries. Lasermark has also developed solutions for global companies with combining laser marking and customer demands for supporting their business. (Lasermark, 2019).

Fusetwin is a startup company that focusing on combining new innovations with old technologies for improving solutions with digital solution. Fusing these technologies for tracking down a product to show for example what, where and who has done something. Tracking products through ledger technology, laser marking and RFID. (Fusetwin, 2019).

Lasermark and Fusetwin are collaborating by using each other’s expertise from each business for combining QR code and software for an innovated solution for companies to utilize.

4.3 Reasons why VEO considers taking QR codes in use

VEO wish to have an accessible platform where they can save selected documents and information that is necessary for customers and for internal VEO use for operation, maintenance, trouble shooting and repair purposes. The key benefit would be that customers have access to these documents on a mobile device and would therefore have a faster way of getting the needed as- built information of the delivery instead of retrieving documentation from archives in paper or file format or having to rely on that the needed documentation still exists on site.

During the warranty period that has been agreed in contract agreements where VEO might have warranty repair obligations even for up to five years, engineers or service personnel from VEO would also have access to the correct documentation when they are for example doing warranty repair work.

Today VEO does not have a defined and systematical way or format of how the Vector product should be recorded or the documentation stored. The documents are a part of the project's final documentation and the content and format is depending of the customer demands and documentation specifications. This can result in difficulties to know who, when and what has been done in the past. This would also be a solution for the customer to keep their maintenance records in one place. How the customer currently keeps their maintenance information varies from company to company, but this could potentially be a better solution for them to consider.

The QR code has a unique code for each project, identifying project specific information and documents that has been saved under the QR code. This will help VEO with tracking correct parts and documents when giving customer support. Checking parts could also be possible in 3D with the app which should make it easier to find the correct parts when searching through layouts. Since Vector is under constant developing and undergoing changes for better solutions, parts can have changed since the day it was sold when the customer requests for information. Having the parts list available by scanning the QR code would simplify the process for the customer when requesting parts order and the correct part order and for VEO employee to see what revision of parts to recognizing the generation of Vector that has been delivered to a specific project.

A specific reason why VEO are investigating in QR codes and an app is regarding red pen drawings. When the engineering team has prepared all project drawings in the office they

are inspected and approved to be sent to manufacturing or installation and these are labeled “For Construction”. Before the commissioning engineer goes to site for final testing and commissioning “For Construction” drawings are printed on yellow papers and put into “Commissioning” folders. The commissioning engineer brings this paper set to site. When the commissioning engineer then starts to test and test as built wiring etc. against “For construction” drawings, each loop/diagram is then marked with green pen to indicate that it has been checked and approved. If changes have been done during manufacturing, installation or testing the commissioning engineer makes the modifications on the equipment and marks the changes in the “For Construction” drawings now in the “Commissioning” folder with a red pen.

All red pen drawings are then returned to VEO’s office to be updated of all changes into “Final Documentation”. The red pen commissioning folders are on site until they are change to “Final as built” drawings as part of the final documentation. The current challenge for VEO is that the commissioning engineer can be at site up to 3-4 weeks, he would also need to get the red pen drawings back to the office for updates of the changes into the final documentation continuously after they have been done by an assistant engineer so that they are implemented into the final documentation when the commissioning engineer has completed the commissioning and all red pen drawings been redone to updated drawings and stored in the final documentation “As built” documents.

By linking current existing solutions such as Vectors webpage with the applications you could combine new and existing solutions. If new innovated solutions were to get added in the future for VEO, the QR code and the application could help with integrating these.

4.4 VEO project documentation

Through interviews with development manager and vice president the current project documentation system for VEO was explained for me. From the workshop 2 I gather information from development manager for VEO and had a separate meeting with vice president for the power distribution unit to collect information of current way of project documentation, handing over project documents to customers, current challenges VEO has with documentation and why keeping correct documentation is important for VEO. These employees were interviewed because of their knowledge and capability to explain and answering question regarding project documentation.

At the moment VEO stores the project documentation on a server hard drive accessible through the company network for the employees. Project files are stored in libraries for each business unit and for each year as shown in figure 7 below.

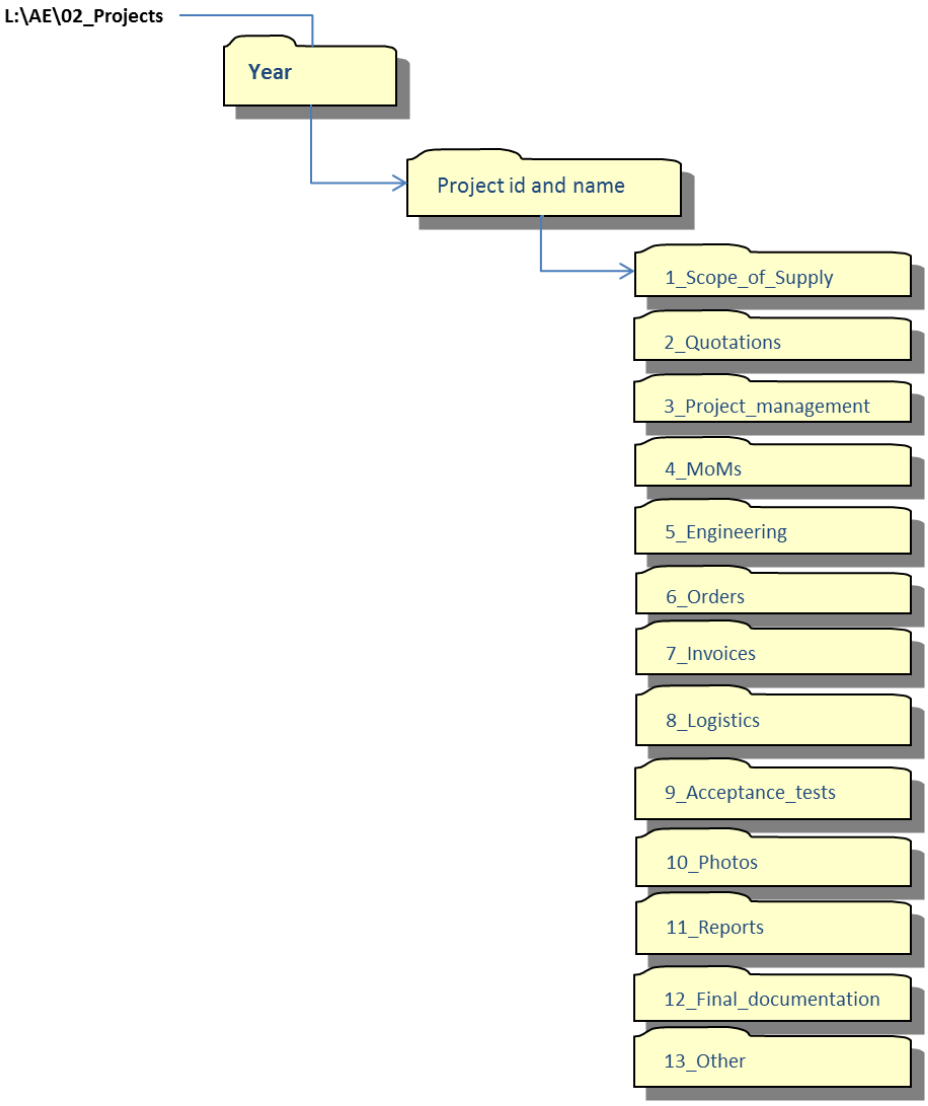

Figure 7. VEO's documentation structure.

The content of each folder is described in VEO project instructions. The instructions contain detailed information of what kind of document should be stored in each folder. When a new project is created a template folder structure is copied and renamed with actual project id and name. The template folders also contain different document templates to be used by the project team. The folder "12_Final_documentation" contains all documentation supplied to the customer as part of the project document delivery. This folder contains all drawings, test protocols, manuals, instructions for operation, maintenance and service for the delivered equipment.

VEO's customers have different requirements of the final documentation structure that VEO follows. Usually today the customer has a documentation system on their company servers. VEO is granted access to a specific project during the duration of the project in order to enter documentation directly to the customers documentation system. In addition to this VEO usually supplies one set of final documentation in paper format that is stored at the site in the electrical room and a copy of the final documentation is also delivered on DVD's or USB drives. Documents within the projects that are in paper format are for example official certificates, permits, quality control documents etc. that the project manager stores in a project binder in paper format. These documents are also scanned and stored in the project folders as a part of the project. Final documentation and the original paper documents are stored in VEO's archive.

The customer has no access to VEO's servers in order to access project documentation. VEO stores the project files a certain amount of years on active project servers and after that they are moved to an archive server or original paper document archive for minimum 10 years. If documents that have been archived are needed for projects, they are to be requested from VEO IT department or retrieved from the original paper document archive.

Normally VEO has a warranty period of 1 - 5 years. If the customer wants to make modifications during this period, they should inform VEO what kind of changes they want to do and VEO should approve them in order to keep the warranty. VEO can also reject a request for modification if they see that it would possess a warranty risk. In this case the customer can proceed with modifications on its own risk after VEO has informed them. In reality many small modifications are done during the warranty period without informing VEO.

In case of failures during the warranty period VEO is totally depended on its own final documentation in order to determine if fault is repaired under warranty by VEO on VEO's cost or if the customer has breached the warranty terms by doing unapproved modifications. In such cases the customer usually reports a warranty claim and VEO is obligated to investigate the reason for the failure and if it is deemed to be a warranty case, repair the fault on its cost. In such cases VEO has the obligation to proof if the warranty claim is justified or not. The final documentation is the only tool VEO has that they can prove what was delivered and the only way to see if the customer has done modifications that is not under warranty.

Currently VEO does not have a solution for when layouts are by hand edited with red pen in factory or on-site during commissioning. To get these red pen edited layouts in digital format, have them clean made to a digital document and up to date revisions of the layouts would be very valuable for VEO. Since currently these documents never gets documented and therefore the documentation is not up to date and correct. Resulting in time wasting steps and making the work more difficult than it should be for the employees.

4.5 Customer project documentation

As described earlier VEO's customers have their own specific requirements of documentation and structure of documentation. VEO's customers use different documentation management system such as M-files, project place and others. Once VEO has delivered the project documentation to the customer it is the customers property free to use and modify accordingly to their needs. VEO does not have access to the customer documentation management system after the project documentation has been handed over and does not know what kind of modifications the customer might have done to the delivered system and related documents.

In this stage VEO didn't want to involve customers for questionnaires about QR codes and mobile application for documentation support and additional information.

4.6 Workshops and interviews

First meeting was held 17th of September with development director from VEO. In this meeting the thesis was discussed, and I got a brief introduction of VEO and the vision of implementing QR codes for Vector.

Second meeting was held October 3th at VEOs office with employees from VEO. Attending were also business developer and programmer from Fusetwin. During this meeting Fusetwin introduced themselves and explained their technology and how combining Fusetwins technology with QR codes could be used with the Fusetwins application. We also got a factory tour of VEO's production and we had the chance to see the Vector product. This meeting was in an early stage of the thesis and gave me a better understanding what the thesis would consist of and how the QR technology works with combining Fusetwin and Lasermark.

Workshop 1 & 2 has been held at Wasa Innovation Center where Fusetwins office is located. The setup for the workshops was done by Fusetwins business developer sent out an agenda beforehand with the key topics on what we needed to be discuss during the workshops. Workshop 3 was held at Vaasan Sähkös headquarters and focused on the pilot project.

During the workshops 1 & 2 we discussed openly and brainstormed around the agenda, questions regarding the collaboration and implementing QR codes. Attendees to the workshops has been business developer and programmers from Fusetwin and development director from VEO. Attendees for workshop 3 was same as for workshop 1, 2 and employees from Vaasan Sähkö.

4.6.1 Workshop 1

First workshop was held October 29th with Fusetwins and Lasermarks CEO and business developer. The focus on the workshop was to discuss and come up with possible solutions and business drivers for using the QR code and Fusetwins application with a smartphone.

During this workshop I was introduced to the application and a demo was showed by Fusetwins business developer. This gave me valuable input on how the application was designed and how it would work. We discussed how the current situation is today and came up with questions that VEO needed to answer. We came to the conclusion that a pilot project would be the best way to collect data for analyzing money/time savings by using QR code against current way of working. Unfortunately, with my time schedule for the thesis and not having suitable projects ongoing the pilot project will be held after my thesis time in VEO.

Since only employees from Fusetwin and myself were attending this first workshop more questions came up for VEO to answer in order to understand how the current way of working is. The conclusion of the first workshop was a good first step towards future discussions and workshops.

4.6.2 Workshop 2

Second workshop was held November 28th with Fusetwins business developer and VEO' development manager. Key topics for the second workshop was to go through the questions that we discussed during the first workshop.

This workshop gave me and Fusetwin more information about how the current way of working is at VEO. VEO's development manager told us about other technologies that VEO has investigated for the future and he also had some valuable input on features that the application could have.

The conclusion from the second workshop was that questions that emerged from the first workshop were answered and new features for the application were discussed.

4.6.3 Workshop 3

For workshop 3 VEO, Fusetwin and Lasermark scheduled a meeting with Vaasan Sähkö. Attendees were development manager from VEO, Fusetwins and Lasermarks CEO and business developer. From Vaasan sähkö participates were project managers and from sales department. The agenda for this meeting was to present the idea of implementing the combination of QR codes and Fusetwins application for a project that VEO sold to Vaasan Sähkö.

After an introduction round, VEO's development manager presented a solution that VEO has been looking into for the future. Thermal cameras for heat tracking components inside Vector. Around thermal cameras discussions were held and Vaasan Sähkö seemed interested about the solution and for a possible solution in the future for service and maintenance purposes.

Second part of the meeting Fusetwins business developer introduced Fusetwin and the solution that VEO, Fusetwin and Lasermark has discussed. How this project between VEO and Vaasan Sähkö could function as a pilot project to collect data and gather information.

What came as a surprise was that Vaasan Sähkö already had internally implemented QR codes for a switchgear and linked it with their recently deployed document management system called M-Files. Currently they had QR code installed in one of their sites for pilot purpose. Vaasan Sähkö also showed us a video which their developer had made for tutorial purpose, on how to use the QR code correctly. Documents as operation, service and layouts were shown that they stored through the QR code.

Therefore, unfortunately the pilot project with Vaasan Sähkö wasn't possible since they had already implemented a similar solution with QR code. The pilot project that VEO, Fusetwin and was hoping for was put on standby until a new suitable project is available.

What knowledge I gathered through this meeting with Vaasan Sähkö was that there is a possibility that many companies today are having or are undergoing development of their documentation management system for smarter/better digital documentation systems. Linking employees' smartphones with the company's documentation management system. Resulting in that they are capable to retrieve documents and needed information from their smartphones at any time and or not necessary in need of an extra tool to support them with documentation or other features.

4.6.4 Interview with Fusetwins business developer

Interview with Fusetwins business developer was held 27th of January at Fusetwins office. The agenda for the interview was a question based on questions that VEOs development manager and I had. Before the interview took place, I created a question template and went it through before the meeting with VEO's development manager for approval.

I used and semi-structured interview meaning that I followed the questions from the template but also discussed freely around the questions. The interview was recorded by phone so that I could go through it afterwards and have it easier to analyze and listen to the answers from the interview.

4.7 Fusetwin smartphone demo app

Fusetwin has developed an app for demo purpose on how their solution on combining Fusetwins application with QR codes would work and giving at the same time VEO opportunity to view the visual aspect of the app. First steps for using the QR code technology would be to have a smartphone and have the Fusetwins app downloaded.

This chapter will go through step by step on how the application works and explain it more in details. Below screenshots from Fusetwins demo app:

Figure 8. Scanning QR code.

When the user wants to enter the data behind the QR code for documentation or information, the user will open the Fusetwin app from user's smartphone and choose the scan option. When the app is in scan mode you keep the smartphones, camera pointed towards the QR code that is located on Vector to get the scan process to begin.

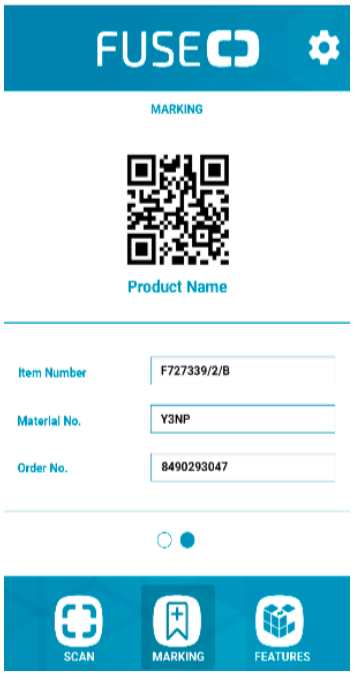

Figure 9. Project specific information.

After a few seconds when the application has scanned the QR code, the application will show to the user project specific information. Here the user should have the possibility to identify the specific project numbers or name.

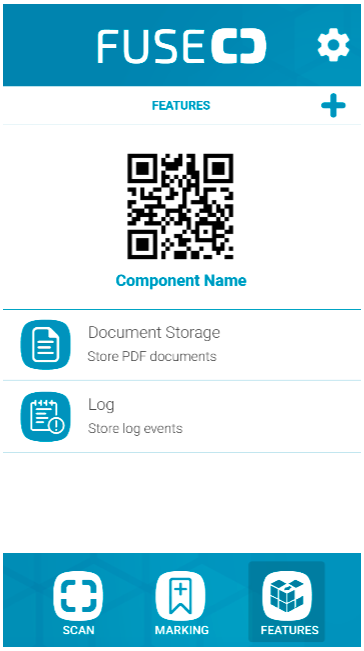

Figure 10. Features option.

The features selection bar as in figure 10 above is the main page for the app. Under the features you will find topics that will lead you to what the user is searching for. This selection bar is very crucial since here all topics for different folders are going to present where the documents and information will be documented. For adding a feature, the user simply must click the plus sign in the up-right corner. Figure 11 shows how it would look when the user clicks the plus sign to add more features. Feature #3 and #4 shows how it would look with added features.

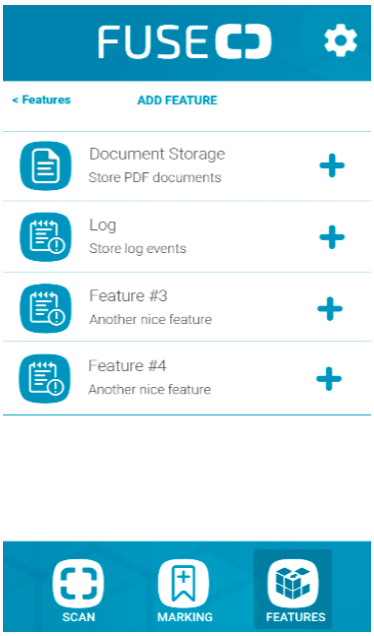

Figure 11. Multiple features.

The log feature option is where maintenance information will be held. Here the history of the maintenance can be stored and tell more specific information about who, what and when something has been done. The log could also alternatively function as an overall log, if the user thinks something has been done and that could be valuable information for others and for the future. The log feature option would function as a fast way to go through the maintenance history of Vector for VEO, customer or third-party service and to identify what, who and when.

When the user wants to add a new log, the user clicks the plus sign.

In figure 12 below shows how the log would be constructed, where the user is supposed to fill all needed information. As the name of the user who is writing the log, date when the log is written, topic of the log and last a description of the purpose of the log.

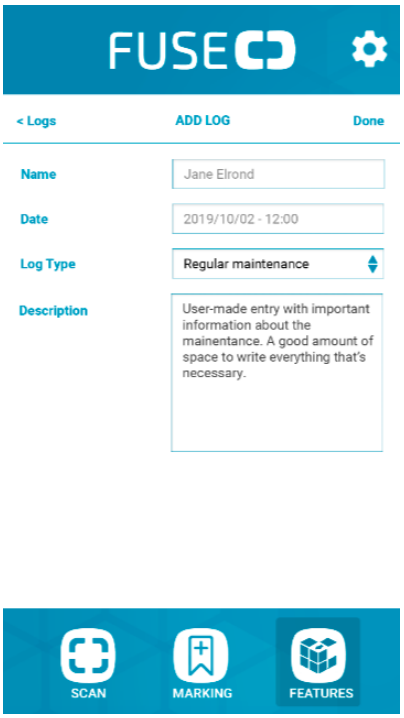

Figure 12. Log setup with name, date, log type and description.

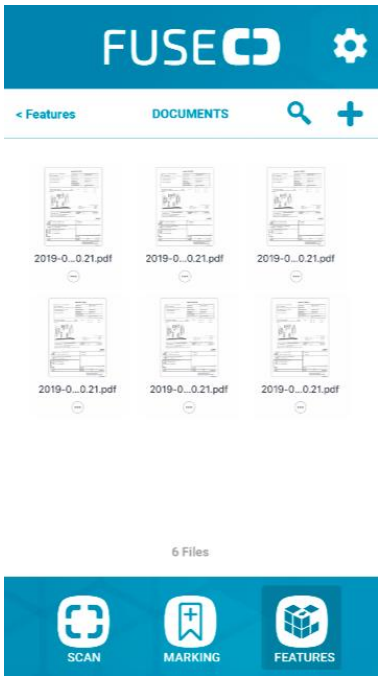

Figure 13. Documents storage.

Above in figure 13 you can see that pdf files can be storage in the app. Here for examples instructions, operation manuals or layouts can be storage for the specific project and Vector.

Figure 14 below shows how it looks when the user wants to open one specific document for a larger view.

Figure 14. Single document viewing.

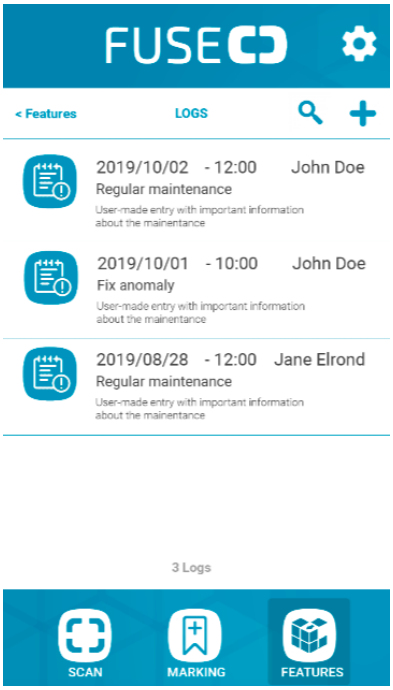

Figure 15. Log feature.

What can be concluded from the demo app then? As mentioned earlier we need to keep in mind that this was only a demo app made by Fusetwin for presentation purpose to give VEO a better understanding how they have visualized how it would look and to have a practical example. For me this demo app was a great first step to start from and to get the feeling of a "hands on" example. In the theory chapter we discussed about key elements for an app and these we can now compare with Fusetwins demo app.

As for simplicity this app has a very clear structure on how it is built, how to use it and the coloring with blue and white goes perfectly with VEO's colors. Especially with the main option bar at the bottom with three options: scan, marking and features makes the app more user-friendly. I think today when people are quite good with technology and familiar with the use of their smartphone with different apps this shouldn't be a problem to learn by simply exploring the different tablets by clicking and viewing them.

Currently the demo app does not include a customer support feature, but this is something that needs to be added. With the customer support feature the customer should have a simple and fast way to contact the right person regarding the specific project by phone, email or chat. As mentioned earlier VEO today can have calls from customer that goes to the reception desk and from there trying to figure out who to contact. That does not give a professional and customer centric picture. Giving fast, simple and correct support to the customer from the beginning is the key to have success in customer support and satisfied customers. Also, a support feature for the app that Fusetwin would be responsible for supporting issues and questions regarding the app.

Now the app is not designed for offline mode, to be able to read the QR code and access the required information the app must have internet connection it is not designed to function without internet connection. It would be possible to develop an offline mode, but this is not currently in the development program of Fusetwin.

Factors that affect the performance of the app are bad or no internet connection, damaged QR code, non-working camera on the mobile device and the software hasn't been updated.

From how the demo app looks in this stage I think some changes could be done for a better structure and better user experience. Below the three main options from the bottom bar from the app:

Scan

The scan option I think looks good and is simple. When you click on it you are in scan mode and ready to scan the QR code. Here I think a manual log in also could be inserted if the user should have problem with the camera or the QR code. Otherwise this option needs to be relatively simple and serve the main function as to scan the QR code.

Marking

The “marking” option tab could be renamed to “product or project” since behind the feature contains basic information regarding the specific project the user has entered with the QR code. As for example material number, project id, project manager, location information and name for the specific project are possible information behind the current “marking” feature.

From the “marking” feature the QR code could also be removed because it is not relative to have there. It will also give more space, better structure and a better visual appearance with only information as names and numbers for the specific project.

Features

Same as for the marking the QR code can be removed also from the features because it does not have a function. For the same reasons as mentioned above to give more space, better structure and better visual appearance. The features tab section I would say is the core for the whole app since here all the features for the different folders are going to be. Therefore, it is crucial the way features are structured, what information and documents are behind each feature. For example, one feature cannot be named “documents” and then behind it a bunch of pdfs or word files because it is too undefined and could then store all sort of different documents under the feature. Here the frustration and time wasting comes into the picture if the user needs to go through every feature under features and different documents to find what the user is searching for. This could result in an unsatisfied user that does not see the point of using the app.

Now the user can add own features, but I think most of the features should be locked and be pre-added to the app. This for creating a clear structure for every project but at the bottom main bar where now the three options are could have one tab named for example “myVEO” where the user could add own features.

Then it would be easy to know what has been manually added, easy to find and as an alternative for the user to add an own feature by user’s choice. Keeping in mind that almost

every project is different and therefore done case by case basis. Acquiring feedback from customer and knowledge from projects VEO and Fusetwin can further develop the app and add features from the beginning in the features option.

5 Results

This chapter will present the result for the thesis. The result for the thesis is based on interviews with employees from Fusetwin and VEO.

The current business model of Fusetwin is that the information / data that is retrieved through the app are located and stored in Fusetwins servers. This storage and the management of data would be provided as a hosted service to VEO. The process of updating possible changes to VEO documentation would need to be discussed and agreed. The QR code Fusetwin would use is the model 1 or 2 from figure 5 since these are the standard QR codes and easiest recognizable QR codes. If customer would require another QR code, it is possible to change on their request. The QR code would be in sticker form as they are easy to produce, mount on the Vector and cheap to produce.

It is possible to link the app to other data storages such as VEO's or Customers databases / servers, but they need be based on a platform that is accessible through internet such as share points, homepages or other applications that allow internet access. Based on the interviews with VEO personnel concerning the apps access to VEO's customer data this would not be allowed, or if it would be allowed the demands on data security and GDPR (General Data Protection Regulation) as Fusetwin also mentioned would be massive and probably not practically doable. As the customers are large national or regional electrical utilities the data on their servers are sensitive and classified as they give access and description of country critical data and systems.
It is not possible for Fusetwins application to access VEO's data where it is stored currently on the L: drive accessible only by being logged in to the internal network as a specified VEO user or from outside trough an VPN tunnel as a specified VEO user. Currently the application does not work without an internet connection and are not designed to function without internet connection. But it could be possible to develop an offline mode if that would be necessary but today wherever you are, internet connection is possible. Currently not possible to log in manually on the app.

The challenge having the documentation on Fusetwins servers is that if a VEO employee wants to add, edit or review the documentation in a project from VEO's office, there is no way to access the documentation as the current business model is. The changes or adding of

documents that needs to be done in the documentation needs to go through Fusetwin and they will execute needed actions.
This would result in manual work as sending documents from VEO to Fusetwin and communicate through emails which doesn't really improve todays process of way of working. This challenge was also recognized by Fusetwin and they need to further investigate and discuss how they could solve this.

If the case would be that data is stored on Fusetwins servers, the data and information on the app would be "basic" information as documents that does not need to be updated often as for example operating manuals since these are all the same thus specific projects. When a project is sold VEO would then gather as seen below in features for the app an information "package" for the customer and VEO employees would send it to Fusetwin that then would host and maintain the documents linking the documentation with the app and QR code.
The documentation that would be accessible from the app cannot be on design level of drawings since its classified information for VEO employees only, accessible from the app would be more external information.

Features for the app:

Documentation storage

- Maintenance manuals
- Installation manuals
- Service schedule
- Operating manuals and video
- Parts lists

Maintenance log

- Name
- Date
- Log type
- Description of the maintenance

VEO Contacts

- Project manager name
    - Phone number
    - Email
- Sales manager name

- Phone number
- Email

App support

- Chat function

Having maintenance, installation, service and operating manuals combined with videos at one place on a digital platform would make work easier and quicker at site. By using fast and simple scanning process having accessible documents at hand in your mobile in a few seconds instead of trying to find needed document from paper files, websites, documentation systems or archives. Also having the possibility to watch a video showing how the work should be done would make it easier, faster and the risk for having a work accidents or damage to the equipment decreases. Instant access to parts lists would make it easier for customer to find correct parts and order new parts if needed, it would also make it easier for VEO employees to recognize different generations of Vector and parts and their actual revision that has been delivered to a specific project.
Having access to maintenance log users can do follow ups and check what has been done in the past. Knowledge also why, when and who has performed some actions and if question arises regarding previous actions that has been carried out. VEO would also have the possibility to proactively notify of what maintenance needs to be carried during Vectors lifecycle under warranty.

Having access to VEO contacts, so that from the start the customer can identify the right VEO people, the service responsible or persons who has been involved in the project and are capable to support or at least forward questions to correct people for answers. Eliminating phone calls to reception desk at VEO headquarter for technical support. Application support in a form of live chat with Fusetwin, where users can contact directly Fusetwin if questions or support is needed for the application.

Fusetwins has flexible data storage since they are using cloud storage, flexible storage means that depending on how much data needs to be stored they can purchase more data storage for optimizing the storage. Fusetwin today has access to free cloud storage, but if they need more data storage for the future paying for cloud storage gets cheaper each year and today the price for cloud storage is around a monthly price of 0,018€ / GB or 18€ / Tera depending on cloud storage provider.

As Fusetwin is a start- up, and the app and business model are in a pilot mode they are open to discuss all customer needs and wants. The development of these are done on a case by case basis and depending of funding of these pilot projects. The products are then created, the cost and customer price are then formed based on this. Also, as VEO at his stage cannot quantify the amount of data that needs to be stored, number of users / licenses, therefore it is difficult to get cost estimates from Fusetwin.

Fusetwin gave an estimated rough ballpark number on how much it could cost, estimations from Fusetwin was around 50€ / Vector / month keeping in mind as said before it is an rough estimate and has factors that needs to be agreed upon before a firm price for the application can be given from Fusetwin. The price would be for one Vector unit and cost would be monthly fee for the time being that has been agreed upon in the contracts. This would mean that a yearly cost of 600€ for one Vector unit in one project when buying Fusetwins service. For example, if VEO sells 20 Vectors in year 2020 and would have Fusetwins service implemented in all sold Vectors it would have a yearly cost of 12 000€ for VEO assuming the price would be a firm price of 50€ per Vector unit a month.

VEO would need to sell this application with needed licenses with the project as a part of the warranty period services as an additional tool to manage the documentation and information. When the warranty period is over and VEO's contractual obligations fulfilled with the contract not in force it would be up to Fusetwin to negotiate an extension of the service with the customer with VEO's approval. Fusetwin would give the customer 1 - 2 months to consider what they want to do. If the customer were to end the subscription of license to the application, Fusetwin would hand over the documentation that has been on the application as a "container package" including all documents, data and information to the customer and then it would be up to the customer to take care of the documentation.

Utilizing Microsoft Teams for red pen drawings

Currently VEO is testing a documentation system called Microsoft Teams that is integrated with VEO's Office 365. If VEO were to implement documentation of projects to Microsoft Teams, they could also solve a problem with the red pen drawings. Red pen drawings were one of the specific problems VEO wanted to investigate if a solution could be with linking QR code and mobile application. Since Microsoft Teams is online documentation system and accessible through mobile VEO employees would be able to take picture with their mobile phone of the red pen drawing and upload the photo directly to VEO's online

documentation system. Therefore, VEO employees does not require an additional tool for solving this challenge but solving it by changing documentation system to an online and mobile accessible documentation system as Microsoft Teams.

This was discovered as an additional solution during the thesis and would be possible for VEO employees to use already today. This would result in a faster working process then current way of working to get the updated red pen drawings into the documentation system and would also be accessible for another employee to do the changes of the photo of the red pen drawing to updated revision into digital form.

This would save time and money for VEO by having someone else than the “specialist” engineer doing the required changes in the drawing this could be an employee with less experience and less salary to carry out and uploading the updated drawing to the final documentation and therefore VEO would save money by changing the process. Time would be saved since the photo of the red pen drawing can be uploaded directly when taken, right away update drawing for updated revision by another VEO employee assisting the engineer at site that has taken and uploaded the photo of the red drawing to the documentation system.

6 Conclusion

The purpose of the thesis was to research linking QR codes with software application for VEO's Vector product. Literature was studied for getting better understanding regarding QR codes, software application and documentation. To also be capable to draw parallels with Fusetwins current business model. The qualitative research method was chosen for collecting information by keeping discussions, workshops and interviews with employees from VEO and Fusetwin. The results present the current business model of the application, possible features for the app and what these different features brings for VEO. Potentially if VEO were to change their documentation system further research would result in new solutions which would need to be investigated. During the thesis an additional solution was discovered as presented in the results for the challenge of red pen drawings using Microsoft Teams.

My conclusion for the thesis would be that further investigation needs to be done and by means of a pilot project to gather more specified information. I think changes in VEO's documentation process and in the IT- system is required to move away of working from the documentation on VEO's L: drive server to a web based online documentation system. If VEO were to implement Microsoft Teams, further research needs to be done to investigate what kind of new opportunities, solutions for using QR code technology and how to fully utilize them.

The concept needs more detailed definition and specifications from VEO for that to be possible, as finding out the cost aspects and thus the earning model is not part of the thesis, the aim was to explore the possibilities of the QR codes based on the requirements and what was available at VEO at the time. Any aspects concerning required documentation structure and document management process, IT- and data storage infrastructure has to be left for further investigations in the case that VEO decides to go further with implementing and taking this concept into commercial use.

My own opinion of the concept of QR code and Fusetwins app is that it has potential but as Fusetwin does not have a commercial ready product but wants to develop the product(s) through a pilot project funded by VEO. VEO does not currently have funding's to fund the pilot at this stage but is interested to further research and develop the concept. Therefore, a final decision to go further with QR technology has not been taken. I also think that the

documentation on the application should reside on VEO's server and be available through VEO's documentation system. It would then be easy for VEO employees working on the projects to add, update and review documentation and information from VEO's office in a fast and easy way.

During the research of information, I realized that use of QR codes in industries or business to business use were limited or at least it felt like it during the research. Main purpose for using QR codes today is for marketing and business to consumer. Much information was available around marketing purposes. Hence it felt that the use of QR codes today does not reach its full potential on how QR codes could be utilized in companies and industries for improving processes, ways of working and not only for marketing purpose in today's digital world.

6.1 Problems

Biggest challenges for me was to get familiar and understand VEO's way of working in different stages in projects and the related process and tools related to this. As during the engineering phase in the office how the documentation process works and how the documentation management is structured. To understand the different work sequences at site and what happens during warranty period since I did not have any previous experience from VEO's process, way of working and the requirements. In the start I had difficulties to formulate and structure my approach for the thesis. How much I would involve Fusetwin in the thesis or should my approach for the thesis be more from scratch based on VEO inputs and with own opinions was something that I was struggling about in the beginning.

Finding previous studies or information of QR codes in industries or in business to business purpose was hard to find. If you were to try find QR codes related to marketing and business to consumer you wouldn't have a problem to find information.

6.2 Further research

Fusetwin could not give precise prices for how much it would cost VEO to implement their solution. Fusetwin would need to get more information and input from VEO regarding data storage and users licenses. As VEO's intention as first stage with this thesis was to investigate the possibilities of QR codes and the related applications and the requirements that would be needed from VEO's side in terms of process, structure of documentation and

the IT- infrastructure a detailed specifications or definitions where not available. With more information cost calculation and return on investment calculation could be made. With a pilot project it would be possible to further research these calculations.

If Microsoft Teams documentation system were to be implemented by VEO, I think new ways of linking QR codes and data/documents could be possible and create a more up to date web-based platform with functionality for its purpose. Therefore, research what Microsoft Teams brings for VEO and how to fully utilize its potential.

6.3 Comments

Finally, I want to thank everyone that has been involved in the thesis. I want to thank VEO Oy and especially Development Manager Ari Pätsi for giving me the opportunity to conduct the thesis, guiding me during the thesis and taking time for questions that I had. Fusetwin and Ross Bailey's for supporting and taking time with meetings/workshops answering question regarding his area of expertise and letting me use Fusetwins demo app in the thesis. From Novia UAS I want to thank Mikael Ehrs for giving tutoring with constructive, fast responses in feedbacks and pushing me throughout the thesis.

7 References

Advantages-disadvatages, n.d.. *Estateqrcodes.* [Online]
Available at: http://www.estateqrcodes.com/advantages-disadvantages.html
[Accessed 13 December 2019].

Beker, I., 2011. *Proceedings / XV international scientific conference on industrial,* Serbia: University of Novi Sad.

Bond, J., 2012. *The Benefits Of Using QR Codes.* [Online]
Available at: https://www.visualmarketing.com.au/the-benefits-of-using-qr-codes/
[Accessed 18 December 2019].

Borko, F., 2011. *Handbook of Augmented Reality,* Florida: Springer Science+Business Media, LLC.

CR-Codes, 2017. *CR-Codes.com.* [Online]
Available at: https://qr-codes.com/qr-codes-for-customer-service/
[Accessed 14 December 2019].

Creswell, J. W., 2008. *Research Design.* 3:rd ed. Los Angeles: Sage Publications, lnc.

Fusetwin, 2019. *Fusetwin.* [Online]
Available at: https://www.fusetwin.com/

Halvorsen, T., 2011. *Fastspot.* [Online]
Available at: https://www.fastspot.com/publications/why-documentation-is-important/
[Accessed 20 December 2019].

IC, 2018. *Why document management system is necessary.* [Online]
Available at: https://icthrive.com/blog/document-management-necessary-organization/
[Accessed 20 December 2019].

Jansson, J. & Andervin, M., 2016. *Att Leda Digital Transformation.* 1:a ed. Helsingborg: Hoi.

Kleinman, S., 2012. *Cyborginstitute.* [Online]
Available at: http://cyborginstitute.org/projects/administration/documentation/
[Accessed 20 December 2019].

Lasermark, 2019. *Lasermark.* [Online]
Available at: https://www.lasermark.fi/

Lincoln, D. & von-Hoersten, H., 2018. *ABB.* [Online]
Available at: https://search-ext.abb.com/library/Download.aspx?DocumentID=AT%2fDynamic_QR_Code%2fABB_Review&LanguageCode=en&DocumentPartId=&Action=Launch
[Accessed 8 January 2019].

Mind, T., 2018. *Mind Tools.* [Online]
Available at: https://www.mindtools.com/pages/article/improving-business-processes.htm
[Accessed 3 December 2019].

Nagar, T., 2019. *Customer Think.* [Online]
Available at: https://customerthink.com/what-are-the-successful-mobile-app-features/
[Accessed 11 December 2019].

Newman, E., 2016. *Yonyx.* [Online]
Available at: https://corp.yonyx.com/customer-service/importance-of-documentation-in-customer-service/
[Accessed 20 December 2019].

Oragui, D., 2018. *The Manifest.* [Online]
Available at: https://themanifest.com/app-development/pros-and-cons-using-qr-codes-market-your-app
[Accessed 12 December 2019].

Shaoolian, G., 2017. *Clutch.* [Online]
Available at: https://clutch.co/app-developers/resources/mobile-app-features
[Accessed 11 December 2019].

State, L., 2017. *Liquid State.* [Online]
Available at: https://liquid-state.com/ingredients-successful-mobile-app/
[Accessed 10 December 2019].

Surbhi, S., 2018. *Key Differences.* [Online]
Available at: https://keydifferences.com/difference-between-qualitative-and-quantitative-research.html
[Accessed 16 December 2019].

Taylor, L., 2017. *Qrcode Meetheed.* [Online]
Available at: http://qrcode.meetheed.com/question17.php
[Accessed 12 December 2019].

VEO, 2018. *VEO.* [Online]
Available at: https://www.veo.fi/wp-content/uploads/2018/10/VEO_vector_LOW.pdf
[Accessed 3 December 2019].

Winter, M., 2010. *Scan Me: Everybody's Guide to the Magical World of QR Codes.* California: Westsong Publishing.